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First Draft

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THE CALIBER NINETY AIRCRAFT GUN

Charles K. Cabeen

18 July 1945

*Author's copy - Phila comm to notes*

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DECLASSIFIED - DCD Directive No. 5200.9,  
27 September 1958



UNITED STATES ARMY ORDNANCE PROJECT  
JOHN MARKLE MINING ENGINEERING HALL  
LAFAYETTE COLLEGE  
EASTON, PENNSYLVANIA

**The Caliber Ninety Aircraft Gun.**

**References:**

- OCM 12562, 1935, records initiation of program for development of weapons for destruction of airplanes.
- OCM 13366, 11 January 1937, records desirable characteristics of aircraft cannon.
- OCM 13515, 8 March 1937, approves project to develop a cal. .90 machine cannon.
- OCM 13638, 26 April 1937, records characteristics of cal. .90 gun as submitted by Artillery Development Manufacturing Service.
- OCM 13841, 12 August 1937, approves rifling characteristics for cal. .90 Automatic Gun T1.
- OCM 14019, 11 November 1937, approves ballistics characteristics of Cal. .90 Automatic Gun.
- OCM 14279, 27 January 1938, approval recommended for T2 and T3 cal. .90 Automatic Guns.
- OCM 14766, 10 October 1940, initiates development of cal..90 Automatic Gun T4.
- Aberdeen Proving Ground Report: "First Partial Report on Development Test of Gun, Automatic .90" T2 and One Hundred Seventh Report on Ordnance Program 5082, " 29 October 1939.
- Aberdeen Proving Ground Report: "One Hundred Seventeenth Partial Report on Functioning and Mechanical Tests of Machine Guns and Machine Gun Accessories and Second Report on Caliber .90 Automatic Aircraft Cannon T2," Ordnance Program 5082.
- Aberdeen Proving Ground Report: " First Partial Test of caliber .90 and First Report on Development Test caliber .90 manufactured by Colt Company." Ordnance Program 5490, 10 April 1941.
- "Notes on Air Corps-Ordnance Conference, Aberdeen Proving Ground." 18 June 1937.

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APG - 1st report 5082

- 38840 - damaged trough + spider
- 38841 - " ammunition
- 38842 - Gun T2 + mount 37mm. T4E1
- 38843 - ammunition

2nd report 5082

- 39228 Broken slots on base plate of magazine
- 39229 damaged ammunition
- 39230 damaged rounds following damaged ammunition of 39229
- 39231 broken washer + ejector claw
- 39253 extraction damage

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Preliminary Report

THE CALIBER NINETY AIRCRAFT GUN

by

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Easton, Pennsylvania

18 July 1945

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~~SECRET~~THE CALIBER .90 AIRCRAFT GUNHistorical Background

Small caliber guns were used with varying success during the first World War and the study of larger sizes was undertaken shortly thereafter. Several versions of the 37-mm gun were tested in 1924 but their weights and recoil power were too great for the airplane structures of that time. It was thought that caliber .50 was the largest gun practical for aircraft armament and experimentation with larger sizes was forbidden.

*Cause of prohibition  
against larger  
guns. Review*

In 1935, European developments showed that effective weapons of the 20-mm class and larger were being developed and the prohibition on United States experiments was lifted. Difficulty was experienced in obtaining foreign samples for testing and it was decided that the Ordnance Department, with the cooperation of the Air Corps, should do its own designing and development.

The initial impetus for the program of large caliber aircraft guns was embodied in a communication from the Secretary of War to the Chief of the Air Corps to initiate, in collaboration with the Chief of Ordnance, a program of investigation for devising weapons for the destruction of airplanes. (OCM 12562.)

*The 1st Cal 90 was designed as A.C.*

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The desirable military characteristics of offensive cannon, listed as first priority, have been given the general introduction. The term aircraft cannon is applied to aircraft armament of caliber .60 or larger.

In March of 1937, a project was approved to develop a caliber .90 machine cannon. (OCM 13515, 8 March 1937) and the Manufacturing Service of the Artillery Division of the Ordnance submitted the following as the expected character of the gun and ammunition: (OCM 13638, 26 April 1937)

|   |                         |
|---|-------------------------|
| Caliber - - - - -                             | .90 in.                 |
| Weight of gun - - - - -                       | 125 lb. (maximum)       |
| Muzzle velocity - - - - -                     | 2850 ft./sec. (minimum) |
| Cyclic rate of fire - - - - -                 | 150 r.p.m.              |
| Force of recoil - - - - -                     | 1000 lb. (maximum)      |
| Weight of 50 round magazine, empty - - - - -  | 20 lb.                  |
| Weight of 50 round magazine, loaded - - - - - | 82 lb.                  |

During the summer of 1937, high officers of the Air Corps and Ordnance Departments held a joint conference at the Aberdeen Proving Ground to discuss the future of aircraft and aircraft armament and other related topics. At that meeting it was stated that manufacturing drawings were being made at Rock Island Arsenal and ammunition being developed. This was listed among items classified as: first priority, offensive,

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cannon of 20-mm minimum having a muzzle velocity of 2850 ft./sec. or greater. (Notes on Air Corps - Ordnance Conference, Aberdeen Proving Ground, Md. 18 June 1937). The rifling characteristics for the Caliber .90 automatic gun, designated as T1, were specified as:

Number of grooves - - - - - 10  
 Depth of grooves - - - - - .01 in.  
 Width of grooves - - - - - .1577 in.  
 Width of lands - - - - - .125 in.  
 Radius of fillets - - - - - .01 in.  
 Twist - uniform, right hand, 1 turn in 30 calibers.

These same rifling characteristics were designated for all models of the caliber .90 - T1, T2, T3, T4.

Design studies were initiated for a caliber .90 automatic gun of the blow-back type (O.O. 472.91/1485) with the foregoing specifications. It was decided, however, that a cartridge case of 5 cubic inches for a caliber .90 gun would be so long that the cyclic rate of fire would be impaired. Because the rate of fire is so important in automatic guns it was felt desirable to maintain the high rate of fire at the expense of other factors, so it was suggested that the muzzle velocity be reduced from 2850 ft./sec. to 2700 ft./sec. and the length of the barrel be increased

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from 60 to 75 calibers and the cartridge case was to be as short and nearly cylindrical as possible. (O.O. 472.91/1492, 28 October 1937).

This change received the approval of the Subcommittee on Aircraft Cannon and Ammunition, which also approved the ballistic characteristics. (OCM 14019, 11 November 1937).

The date, 11 November 1937, appears to be the last mention of the caliber .90 automatic cannon which could be designated as model T1. It was never built but was a hypothetical model from which other designs were elaborated.

Two design studies of the caliber .90 gun were submitted by the Artillery Division, Manufacturing Service (drawings AD-C308, AD-C309). (First Indorsement O.O. 472.91/1485, 20 January 1938). The design, called T2, incorporated the differential recoil principle, wherein the round is fired approximately .6 in. from its "home" position in the gun chamber, thus, through the cushioning effect of the powder gases, the forward movement of the counterrecoiling parts is checked and the initial velocity of the recoiling parts is reduced.

The other design, called T3, has the round firing approximately .125 in. from its "home" position, but

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in this case the forward motion of the counterrecoiling parts is checked by counterrecoil hydraulic buffers. and the initial velocity of the recoiling parts is controlled by the orifices in the buffer chamber.

In both models, springs absorb the remaining energy in the recoiling parts and return them to battery position. (OCM 14279, 27 January 1938).

The development of models T2 and T3 seem to have been undertaken by the Watervliet Arsenal which reports progress with a new lightweight gun on 31 July 1941 and a new rubber buffer tested 31 September 1941. The project was reported about 99 percent completed on 30 March 1942. This lightweight model may be the T2E2 for which a project cancellation was asked on 7 April 1942. The reason for the cancellation was that it was not considered practical to add a new caliber to those then in use and any new principles evolved could be applied to existing cannon. The cancellation request on T2E2 was withdrawn on 26 June 1942 because it was felt that information gained might be useful in the future and a loss of valuable experience would result from dropping the project. Up to 20 October 1942 no new work had been done on the T2E2 because of other work.

T2

See Tests  
APGmt

5082

'39-'40

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The only model of the caliber .90 gun to reach the pilot model stage and to actually be tested by firing was the T4. This was a recoil operated gun, similar to the 37-mm gun M1A1 but differing in that it was designed for a two way feed either by flat clips or flexible belt in a drum, though the latter was not tried. The muzzle velocity was reduced from 2850 ft./sec. to 2700 ft./sec. in accordance with the modified design previously cited. (OCM 14766, 10 October 1940). Manufacture was by a private concern.

At the time of testing the T4 was considered as an antitank gun and the officers witnessing the test were from the Ordnance, Infantry and Cavalry but there were no Air Corps representatives.

The tests took place at the Aberdeen Proving Ground on 14 and 20, March 1941. Tests were conducted with both tripod and Solothurn wheel mount. The wheel mount proved inadequate for the strength of the recoil and the trails of the mount were permanently deformed.

Certain changes pointing toward improved performance and design were recommended as a result of the test.

(Aberdeen Proving Ground Report, Ordnance Program 5490).

No further work on the T4 model seems to have been

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done and though no mention is made of abandoning the project, it is to be presumed that future developments await the need for a weapon of this caliber.

*Questions:*

1. Was T4 even standardized as an A.T.
2. Was T1 " made
3. Was T2 project

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